

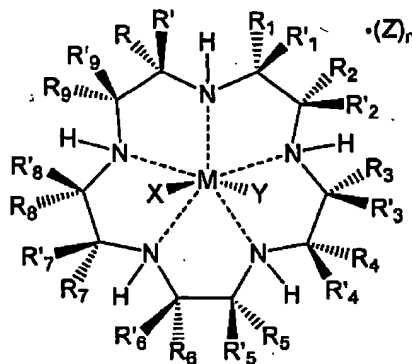
Application No. 09/580,007

Amendment dated March 28, 2004

Reply to Office Action of September 28, 2004

### AMENDMENTS TO THE CLAIMS

1. (Cancelled)
2. (Previously amended) The modified biomaterial of claim 197, wherein the non-proteinaceous catalyst for the dismutation of superoxide is selected from the group consisting of manganese(II) pentaaza complexes, manganese(III) pentaaza complexes, iron(II) pentaaza complexes, iron(III) pentaaza complexes, manganese(II) salen complexes, manganese(III) salen complexes, iron(II) salen complexes, iron(III) salen complexes, manganese(II) porphyrin complexes, manganese(III) porphyrin complexes, iron(II) porphyrin complexes, and iron(III) porphyrin complexes.
3. (Previously amended) The modified biomaterial of claim 197, wherein the non-proteinaceous catalyst for the dismutation of superoxide is selected from the group consisting of manganese and iron chelates of pentaazacyclopentadecane compounds, which are represented by the following formula:



wherein M is a cation of a transition metal selected from the group consisting of manganese and iron;

wherein R, R', R<sub>1</sub>, R'<sub>1</sub>, R<sub>2</sub>, R'<sub>2</sub>, R<sub>3</sub>, R'<sub>3</sub>, R<sub>4</sub>, R'<sub>4</sub>, R<sub>5</sub>, R'<sub>5</sub>, R<sub>6</sub>, R'<sub>6</sub>, R<sub>7</sub>, R'<sub>7</sub>, R<sub>8</sub>, R'<sub>8</sub>, R<sub>9</sub>, and R'<sub>9</sub> independently represent hydrogen, or substituted or unsubstituted alkyl, alkenyl, alkynyl, cycloalkyl, cycloalkenyl, cycloalkylalkyl, cycloalkylcycloalkyl, cycloalkenylalkyl, alkylcycloalkyl, alkylcycloalkenyl, alkenylcycloalkyl, alkenylcycloalkenyl, heterocyclic, aryl and aralkyl radicals;

wherein R<sub>1</sub> or R'<sub>1</sub> and R<sub>2</sub> or R'<sub>2</sub>, R<sub>3</sub> or R'<sub>3</sub> and R<sub>4</sub> or R'<sub>4</sub>, R<sub>5</sub> or R'<sub>5</sub> and R<sub>6</sub> or R'<sub>6</sub>, R<sub>7</sub> or R'<sub>7</sub> and R<sub>8</sub> or R'<sub>8</sub>, and R<sub>9</sub> or R'<sub>9</sub> and R or R' together with the carbon atoms to which they are attached independently form a substituted or unsubstituted, saturated, partially saturated or unsaturated cyclic or heterocyclic having 3 to 20 carbon atoms;

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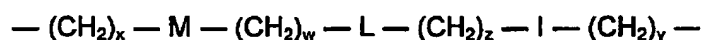
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wherein R or R' and R<sub>1</sub> or R'<sub>1</sub>, R<sub>2</sub> or R'<sub>2</sub> and R<sub>3</sub> or R'<sub>3</sub>, R<sub>4</sub> or R'<sub>4</sub> and R<sub>5</sub> or R'<sub>5</sub>, R<sub>6</sub> or R'<sub>6</sub> and R<sub>7</sub> or R'<sub>7</sub>, and R<sub>8</sub> or R'<sub>8</sub> and R<sub>9</sub> or R'<sub>9</sub> together with the carbon atoms to which they are attached independently form a substituted or unsubstituted nitrogen containing heterocycle having 2 to 20 carbon atoms, provided that when the nitrogen containing heterocycle is an aromatic heterocycle which does not contain a hydrogen attached to the nitrogen, the hydrogen attached to the nitrogen as shown in the above formula, which nitrogen is also in the macrocyclic ligand or complex, and the R groups attached to the included carbon atoms of the macrocycle are absent;

wherein R and R', R<sub>1</sub> and R'<sub>1</sub>, R<sub>2</sub> and R'<sub>2</sub>, R<sub>3</sub> and R'<sub>3</sub>, R<sub>4</sub> and R'<sub>4</sub>, R<sub>5</sub> and R'<sub>5</sub>, R<sub>6</sub> and R'<sub>6</sub>, R<sub>7</sub> and R'<sub>7</sub>, R<sub>8</sub> and R'<sub>8</sub>, and R<sub>9</sub> and R'<sub>9</sub> together with the carbon atom to which they are attached independently form a saturated, partially saturated, or unsaturated cyclic or heterocyclic having 3 to 20 carbon atoms; and

wherein one of R, R', R<sub>1</sub>, R'<sub>1</sub>, R<sub>2</sub>, R'<sub>2</sub>, R<sub>3</sub>, R'<sub>3</sub>, R<sub>4</sub>, R'<sub>4</sub>, R<sub>5</sub>, R'<sub>5</sub>, R<sub>6</sub>, R'<sub>6</sub>, R<sub>7</sub>, R'<sub>7</sub>, R<sub>8</sub>, R'<sub>8</sub>, R<sub>9</sub>, and R'<sub>9</sub> together with a different one of R, R', R<sub>1</sub>, R'<sub>1</sub>, R<sub>2</sub>, R'<sub>2</sub>, R<sub>3</sub>, R'<sub>3</sub>, R<sub>4</sub>, R'<sub>4</sub>, R<sub>5</sub>, R'<sub>5</sub>, R<sub>6</sub>, R'<sub>6</sub>, R<sub>7</sub>, R'<sub>7</sub>, R<sub>8</sub>, R'<sub>8</sub>, R<sub>9</sub>, and R'<sub>9</sub> which is attached to a different carbon atom in the macrocyclic ligand may be bound to form a strap represented by the formula:



wherein w, x, y and z independently are integers from 0 to 10 and M, L and J are independently selected from the group consisting of alkyl, alkenyl, alkynyl, aryl, cycloalkyl, heteroaryl, alkaryl, alkheteroaryl, aza, amide, ammonium, oxa, thia, sulfonyl, sulfinyl, sulfonamide, phosphoryl, phosphinyl, phosphino, phosphonium, keto, ester, alcohol, carbamate, urea, thiocarbonyl, borates, boranes, boraza, silyl, siloxy, silaza and combinations thereof; and combinations thereof; and

wherein X, Y and Z are independently selected from the group consisting of halide, oxo, aquo, hydroxo, alcohol, phenol, dioxygen, peroxy, hydroperoxy, alkylperoxy, arylperoxy, ammonia, alkylamino, arylamino, heterocycloalkyl amino, heterocycloaryl amino, amine oxides, hydrazine, alkyl hydrazine, aryl hydrazine, nitric oxide, cyanide, cyanate, thiocyanate, isocyanate, isothiocyanate, alkyl nitrile, aryl nitrile, alkyl isonitrile, aryl isonitrile, nitrate, nitrite, azido, alkyl sulfonic acid, aryl sulfonic acid, alkyl sulfoxide, aryl sulfoxide, alkyl aryl sulfoxide, alkyl sulfenic acid, aryl sulfenic acid, alkyl sulfinic acid, aryl sulfinic acid, alkyl thiol carboxylic acid, aryl thiol carboxylic acid, alkyl thiol thiocarboxylic acid, aryl thiol thiocarboxylic acid, alkyl carboxylic acid (such as acetic acid, trifluoroacetic acid, oxalic acid), aryl carboxylic acid (such as benzoic acid, phthalic acid), urea, alkyl urea, aryl urea, alkyl aryl urea, thiourea, alkyl

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thiourea, aryl thiourea, alkyl aryl thiourea, sulfate, sulfite, bisulfate, bisulfite, thiosulfate, thiosulfite, hydrosulfite, alkyl phosphine, aryl phosphine, alkyl phosphine oxide, aryl phosphine oxide, alkyl aryl phosphine oxide, alkyl phosphine sulfide, aryl phosphine sulfide, alkyl aryl phosphine sulfide, alkyl phosphonic acid, aryl phosphonic acid, alkyl phosphinic acid, aryl phosphinic acid, alkyl phosphinous acid, aryl phosphinous acid, phosphate, thiophosphate, phosphite, pyrophosphite, triphosphate, hydrogen phosphate, dihydrogen phosphate, alkyl guanidino, aryl guanidino, alkyl aryl guanidino, alkyl carbamate, aryl carbamate, alkyl aryl carbamate, alkyl thiocarbamate, aryl thiocarbamate, alkyl aryl thiocarbamate, alkyl dithiocarbamate, aryl dithiocarbamate, alkyl aryl dithiocarbamate, bicarbonate, carbonate, perchlorate, chlorate, chlorite, hypochlorite, perbromate, bromate, bromite, hypobromite, tetrahalomanganate, tetrafluoroborate, hexafluorophosphate, hexafluoroantimonate, hypophosphite, iodate, periodate, metaborate, tetraaryl borate, tetra alkyl borate, tartrate, salicylate, succinate, citrate, ascorbate, saccharinate, amino acid, hydroxamic acid, thiotosylate, and anions of ion exchange resins.

4. (Previously amended) The modified biomaterial of claim 197, wherein the non-proteinaceous catalyst for the dismutation of superoxide is selected from the group consisting of Compounds 1-54 of Table 1.

5. (Previously amended) The modified biomaterial of claim 197, wherein the non-proteinaceous catalyst for the dismutation of superoxide is selected from the group consisting of Compounds 16, 27, 38, 40, 42, 43, 51, 52, 53, and 54 of Table 1.

6. (Previously amended) The modified biomaterial of claim 2, 3, 4, or 5, wherein the non-proteinaceous catalyst is present at a concentration of about 0.001 to about 25 weight percent.

7. (Previously amended) The modified biomaterial of claim 2, 3, 4, or 5, wherein the non-proteinaceous catalyst is present at a concentration of about 0.01 to about 10 weight percent.

8. (Previously amended) The modified biomaterial of claim 2, 3, 4, or 5, wherein the non-proteinaceous catalyst is present at a concentration of about 0.05 to about 5 weight percent.

9. (Previously amended) The modified biomaterial of claim 197, wherein the biomaterial substantially compatible with a biological system is selected from the group consisting of metals, ceramics, polymers, biopolymers, and composites thereof.

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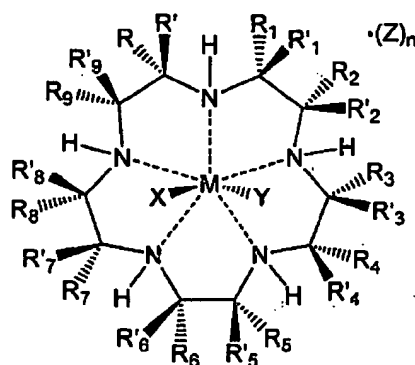
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10. (Previously amended) The modified biomaterial of claim 197, wherein the biomaterial substantially compatible with a biological system is a metal selected from the group consisting of stainless steel, tantalum, titanium, nitinol, gold, platinum, inconel, iridium, silver, tungsten, nickel, chromium, vanadium, and alloys comprising any of the foregoing metals and alloys.

11. (Previously amended) The modified biomaterial of claim 10, wherein the non-proteinaceous catalyst for the dismutation of superoxide is selected from the group consisting of manganese(II) pentaaza complexes, manganese(III) pentaaza complexes, iron(II) pentaaza complexes, iron(III) pentaaza complexes, manganese(II) salen complexes, manganese(III) salen complexes, iron(II) salen complexes, iron(III) salen complexes, manganese(II) porphyrin complexes, manganese(III) porphyrin complexes, iron(II) porphyrin complexes, and iron(III) porphyrin complexes.

12. (Previously amended) The modified biomaterial of claim 10, wherein the non-proteinaceous catalyst for the dismutation of superoxide is selected from the group consisting of manganese and iron chelates of pentaazacyclopentadecane compounds, which are represented by the following formula:



wherein M is a cation of a transition metal selected from the group consisting of manganese and iron;

wherein R, R', R<sub>1</sub>, R'<sub>1</sub>, R<sub>2</sub>, R'<sub>2</sub>, R<sub>3</sub>, R'<sub>3</sub>, R<sub>4</sub>, R'<sub>4</sub>, R<sub>5</sub>, R'<sub>5</sub>, R<sub>6</sub>, R'<sub>6</sub>, R<sub>7</sub>, R'<sub>7</sub>, R<sub>8</sub>, R'<sub>8</sub>, R<sub>9</sub>, and R'<sub>9</sub> independently represent hydrogen, or substituted or unsubstituted alkyl, alkenyl, alkynyl, cycloalkyl, cycloalkenyl, cycloalkylalkyl, cycloalkylcycloalkyl, cycloalkenylalkyl, alkylcycloalkyl, alkylcycloalkenyl, alkenylcycloalkyl, alkenylcycloalkenyl, heterocyclic, aryl and aralkyl radicals;

wherein R<sub>1</sub> or R'<sub>1</sub> and R<sub>2</sub> or R'<sub>2</sub>, R<sub>3</sub> or R'<sub>3</sub> and R<sub>4</sub> or R'<sub>4</sub>, R<sub>5</sub> or R'<sub>5</sub> and R<sub>6</sub> or R'<sub>6</sub>, R<sub>7</sub> or R'<sub>7</sub> and R<sub>8</sub> or R'<sub>8</sub>, and R<sub>9</sub> or R'<sub>9</sub> and R or R' together with the carbon atoms to which they are

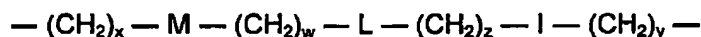
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attached independently form a substituted or unsubstituted, saturated, partially saturated or unsaturated cyclic or heterocyclic having 3 to 20 carbon atoms;

wherein R or R' and R<sub>1</sub> or R'<sub>1</sub>, R<sub>2</sub> or R'<sub>2</sub> and R<sub>3</sub> or R'<sub>3</sub>, R<sub>4</sub> or R'<sub>4</sub> and R<sub>5</sub> or R'<sub>5</sub>, R<sub>6</sub> or R'<sub>6</sub> and R<sub>7</sub> or R'<sub>7</sub>, and R<sub>8</sub> or R'<sub>8</sub> and R<sub>9</sub> or R'<sub>9</sub> together with the carbon atoms to which they are attached independently form a substituted or unsubstituted nitrogen containing heterocycle having 2 to 20 carbon atoms, provided that when the nitrogen containing heterocycle is an aromatic heterocycle which does not contain a hydrogen attached to the nitrogen, the hydrogen attached to the nitrogen as shown in the above formula, which nitrogen is also in the macrocyclic ligand or complex, and the R groups attached to the included carbon atoms of the macrocycle are absent;

wherein R and R', R<sub>1</sub> and R'<sub>1</sub>, R<sub>2</sub> and R'<sub>2</sub>, R<sub>3</sub> and R'<sub>3</sub>, R<sub>4</sub> and R'<sub>4</sub>, R<sub>5</sub> and R'<sub>5</sub>, R<sub>6</sub> and R'<sub>6</sub>, R<sub>7</sub> and R'<sub>7</sub>, R<sub>8</sub> and R'<sub>8</sub>, and R<sub>9</sub> and R'<sub>9</sub> together with the carbon atom to which they are attached independently form a saturated, partially saturated, or unsaturated cyclic or heterocyclic having 3 to 20 carbon atoms; and

wherein one of R, R', R<sub>1</sub>, R'<sub>1</sub>, R<sub>2</sub>, R'<sub>2</sub>, R<sub>3</sub>, R'<sub>3</sub>, R<sub>4</sub>, R'<sub>4</sub>, R<sub>5</sub>, R'<sub>5</sub>, R<sub>6</sub>, R'<sub>6</sub>, R<sub>7</sub>, R'<sub>7</sub>, R<sub>8</sub>, R'<sub>8</sub>, R<sub>9</sub>, and R'<sub>9</sub> together with a different one of R, R', R<sub>1</sub>, R'<sub>1</sub>, R<sub>2</sub>, R'<sub>2</sub>, R<sub>3</sub>, R'<sub>3</sub>, R<sub>4</sub>, R'<sub>4</sub>, R<sub>5</sub>, R'<sub>5</sub>, R<sub>6</sub>, R'<sub>6</sub>, R<sub>7</sub>, R'<sub>7</sub>, R<sub>8</sub>, R'<sub>8</sub>, R<sub>9</sub>, and R'<sub>9</sub> which is attached to a different carbon atom in the macrocyclic ligand may be bound to form a strap represented by the formula:



wherein w, x, y and z independently are integers from 0 to 10 and M, L and J are independently selected from the group consisting of alkyl, alkenyl, alkynyl, aryl, cycloalkyl, heteroaryl, alkaryl, alkheteroaryl, aza, amide, ammonium, oxa, thia, sulfonyl, sulfinyl, sulfonamide, phosphoryl, phosphinyl, phosphino, phosphonium, keto, ester, alcohol, carbamate, urea, thiocarbonyl, borates, boranes, boraza, silyl, siloxy, silaza and combinations thereof; and combinations thereof; and

wherein X, Y and Z are independently selected from the group consisting of halide, oxo, aquo, hydroxo, alcohol, phenol, dioxygen, peroxo, hydroperoxo, alkylperoxo, arylperoxo, ammonia, alkylamino, arylamino, heterocycloalkyl amino, heterocycloaryl amino, amine oxides, hydrazine, alkyl hydrazine, aryl hydrazine, nitric oxide, cyanide, cyanate, thiocyanate, isocyanate, isothiocyanate, alkyl nitrile, aryl nitrile, alkyl isonitrile, aryl isonitrile, nitrate, nitrite, azido, alkyl sulfonic acid, aryl sulfonic acid, alkyl sulfoxide, aryl sulfoxide, alkyl aryl sulfoxide, alkyl sulfenic acid, aryl sulfenic acid, alkyl sulfinic acid, aryl sulfinic acid, alkyl thiol carboxylic acid, aryl thiol carboxylic acid, alkyl thiol thiocarboxylic acid, aryl thiol thiocarboxylic acid, alkyl

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carboxylic acid (such as acetic acid, trifluoroacetic acid, oxalic acid), aryl carboxylic acid (such as benzoic acid, phthalic acid), urea, alkyl urea, aryl urea, alkyl aryl urea, thiourea, alkyl thiourea, aryl thiourea, alkyl aryl thiourea, sulfate, sulfite, bisulfate, bisulfite, thiosulfate, thiosulfite, hydrosulfite, alkyl phosphine, aryl phosphine, alkyl phosphine oxide, aryl phosphine oxide, alkyl aryl phosphine oxide, alkyl phosphine sulfide, aryl phosphine sulfide, alkyl aryl phosphine sulfide, alkyl phosphonic acid, aryl phosphonic acid, alkyl phosphinic acid, aryl phosphinic acid, alkyl phosphinous acid, aryl phosphinous acid, phosphate, thiophosphate, phosphite, pyrophosphite, triphosphate, hydrogen phosphate, dihydrogen phosphate, alkyl guanidino, aryl guanidino, alkyl aryl guanidino, alkyl carbamate, aryl carbamate, alkyl aryl carbamate, alkyl thiocarbamate, aryl thiocarbamate, alkyl aryl thiocarbamate, alkyl dithiocarbamate, aryl dithiocarbamate, alkyl aryl dithiocarbamate, bicarbonate, carbonate, perchlorate, chlorate, chlorite, hypochlorite, perbromate, bromate, bromite, hypobromite, tetrahalomanganate, tetrafluoroborate, hexafluorophosphate, hexafluoroantimonate, hypophosphite, iodate, periodate, metaborate, tetraaryl borate, tetra alkyl borate, tartrate, salicylate, succinate, citrate, ascorbate, saccharinate, amino acid, hydroxamic acid, thiotosylate, and anions of ion exchange resins.

13. (Previously amended) The modified biomaterial of claim 10, wherein the non-proteinaceous catalyst for the dismutation of superoxide is selected from the group consisting of Compounds 1-54 of Table 1.

14. (Previously amended) The modified biomaterial of claim 10, wherein the non-proteinaceous catalyst for the dismutation of superoxide is selected from the group consisting of Compounds 16, 27, 38, 40, 42, 43, 51, 52, 53, and 54 of Table 1.

15. (Previously amended) The modified biomaterial of claim 11, 12, 13, or 14, wherein the non-proteinaceous catalyst is present at a concentration of about 0.001 to about 25 weight percent.

16. (Previously amended) The modified biomaterial of claim 11, 12, 13, or 14, wherein the non-proteinaceous catalyst is present at a concentration of about 0.01 to about 10 weight percent.

17. (Previously amended) The modified biomaterial of claim 11, 12, 13, or 14, wherein the non-proteinaceous catalyst is present at a concentration of about 0.05 to about 5 weight percent.

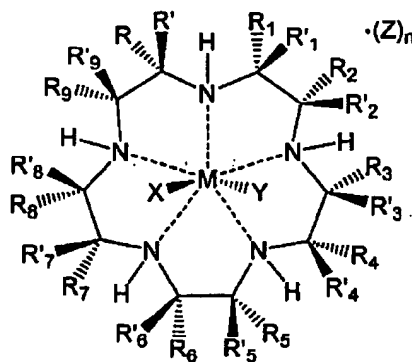
18. (Previously amended) The modified biomaterial of claim 197, wherein the biomaterial substantially compatible with a biological system is a ceramic selected from the

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group consisting of hydroxyapatite, tricalcium phosphate, and aluminum-calcium-phosphorous oxide.

19. (Previously amended) The modified biomaterial of claim 18, wherein the non-proteinaceous catalyst for the dismutation of superoxide is selected from the group consisting of manganese(II) pentaaza complexes, manganese(III) pentaaza complexes, iron(II) pentaaza complexes, iron(III) pentaaza complexes, manganese(II) salen complexes, manganese(III) salen complexes, iron(II) salen complexes, iron(III) salen complexes, manganese(II) porphyrin complexes, manganese(III) porphyrin complexes, iron(II) porphyrin complexes, and iron(III) porphyrin complexes.

20. (Previously amended) The modified biomaterial of claim 18, wherein the non-proteinaceous catalyst for the dismutation of superoxide is selected from the group consisting of manganese and iron chelates of pentaazacyclopentadecane compounds, which are represented by the following formula:



wherein M is a cation of a transition metal selected from the group consisting of manganese and iron;

wherein R, R', R<sub>1</sub>, R'<sub>1</sub>, R<sub>2</sub>, R'<sub>2</sub>, R<sub>3</sub>, R'<sub>3</sub>, R<sub>4</sub>, R'<sub>4</sub>, R<sub>5</sub>, R'<sub>5</sub>, R<sub>6</sub>, R'<sub>6</sub>, R<sub>7</sub>, R'<sub>7</sub>, R<sub>8</sub>, R'<sub>8</sub>, R<sub>9</sub>, and R'<sub>9</sub> independently represent hydrogen, or substituted or unsubstituted alkyl, alkenyl, alkynyl, cycloalkyl, cycloalkenyl, cycloalkylalkyl, cycloalkylcycloalkyl, cycloalkenylalkyl, alkylcycloalkyl, alkylcycloalkenyl, alkenylcycloalkyl, alkenylcycloalkenyl, heterocyclic, aryl and aralkyl radicals;

wherein R<sub>1</sub> or R'<sub>1</sub> and R<sub>2</sub> or R'<sub>2</sub>, R<sub>3</sub> or R'<sub>3</sub> and R<sub>4</sub> or R'<sub>4</sub>, R<sub>5</sub> or R'<sub>5</sub> and R<sub>6</sub> or R'<sub>6</sub>, R<sub>7</sub> or R'<sub>7</sub> and R<sub>8</sub> or R'<sub>8</sub>, and R<sub>9</sub> or R'<sub>9</sub> and R or R' together with the carbon atoms to which they are attached independently form a substituted or unsubstituted, saturated, partially saturated or unsaturated cyclic or heterocyclic having 3 to 20 carbon atoms;

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wherein R or R' and R<sub>1</sub> or R'<sub>1</sub>, R<sub>2</sub> or R'<sub>2</sub> and R<sub>3</sub> or R'<sub>3</sub>, R<sub>4</sub> or R'<sub>4</sub> and R<sub>5</sub> or R'<sub>5</sub>, R<sub>6</sub> or R'<sub>6</sub> and R<sub>7</sub> or R'<sub>7</sub>, and R<sub>8</sub> or R'<sub>8</sub> and R<sub>9</sub> or R'<sub>9</sub> together with the carbon atoms to which they are attached independently form a substituted or unsubstituted nitrogen containing heterocycle having 2 to 20 carbon atoms, provided that when the nitrogen containing heterocycle is an aromatic heterocycle which does not contain a hydrogen attached to the nitrogen, the hydrogen attached to the nitrogen as shown in the above formula, which nitrogen is also in the macrocyclic ligand or complex, and the R groups attached to the included carbon atoms of the macrocycle are absent;

wherein R and R', R<sub>1</sub> and R'<sub>1</sub>, R<sub>2</sub> and R'<sub>2</sub>, R<sub>3</sub> and R'<sub>3</sub>, R<sub>4</sub> and R'<sub>4</sub>, R<sub>5</sub> and R'<sub>5</sub>, R<sub>6</sub> and R'<sub>6</sub>, R<sub>7</sub> and R'<sub>7</sub>, R<sub>8</sub> and R'<sub>8</sub>, and R<sub>9</sub> and R'<sub>9</sub> together with the carbon atom to which they are attached independently form a saturated, partially saturated, or unsaturated cyclic or heterocyclic having 3 to 20 carbon atoms; and

wherein one of R, R', R<sub>1</sub>, R'<sub>1</sub>, R<sub>2</sub>, R'<sub>2</sub>, R<sub>3</sub>, R'<sub>3</sub>, R<sub>4</sub>, R'<sub>4</sub>, R<sub>5</sub>, R'<sub>5</sub>, R<sub>6</sub>, R'<sub>6</sub>, R<sub>7</sub>, R'<sub>7</sub>, R<sub>8</sub>, R'<sub>8</sub>, R<sub>9</sub>, and R'<sub>9</sub> together with a different one of R, R', R<sub>1</sub>, R'<sub>1</sub>, R<sub>2</sub>, R'<sub>2</sub>, R<sub>3</sub>, R'<sub>3</sub>, R<sub>4</sub>, R'<sub>4</sub>, R<sub>5</sub>, R'<sub>5</sub>, R<sub>6</sub>, R'<sub>6</sub>, R<sub>7</sub>, R'<sub>7</sub>, R<sub>8</sub>, R'<sub>8</sub>, R<sub>9</sub>, and R'<sub>9</sub> which is attached to a different carbon atom in the macrocyclic ligand may be bound to form a strap represented by the formula:



wherein w, x, y and z independently are integers from 0 to 10 and M, L and J are independently selected from the group consisting of alkyl, alkenyl, alkynyl, aryl, cycloalkyl, heteroaryl, alkaryl, alkheteroaryl, aza, amide, ammonium, oxa, thia, sulfonyl, sulfinyl, sulfonamide, phosphoryl, phosphinyl, phosphino, phosphonium, keto, ester, alcohol, carbamate, urea, thiocarbonyl, borates, boranes, boraza, silyl, siloxy, silaza and combinations thereof; and combinations thereof; and

wherein X, Y and Z are independently selected from the group consisting of halide, oxo, aquo, hydroxo, alcohol, phenol, dioxygen, peroxo, hydroperoxo, alkylperoxo, arylperoxo, ammonia, alkylamino, arylamino, heterocycloalkyl amino, heterocycloaryl amino, amine oxides, hydrazine, alkyl hydrazine, aryl hydrazine, nitric oxide, cyanide, cyanate, thiocyanate, isocyanate, isothiocyanate, alkyl nitrile, aryl nitrile, alkyl isonitrile, aryl isonitrile, nitrate, nitrite, azido, alkyl sulfonic acid, aryl sulfonic acid, alkyl sulfoxide, aryl sulfoxide, alkyl aryl sulfoxide, alkyl sulfenic acid, aryl sulfenic acid, alkyl sulfinic acid, aryl sulfinic acid, alkyl thiol carboxylic acid, aryl thiol carboxylic acid, alkyl thiol thiocarboxylic acid, aryl thiol thiocarboxylic acid, alkyl carboxylic acid (such as acetic acid, trifluoroacetic acid, oxalic acid), aryl carboxylic acid (such as benzoic acid, phthalic acid), urea, alkyl urea, aryl urea, alkyl aryl urea, thiourea, alkyl



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thiourea, aryl thiourea, alkyl aryl thiourea, sulfate, sulfite, bisulfate, bisulfite, thiosulfate, thiosulfite, hydrosulfite, alkyl phosphine, aryl phosphine, alkyl phosphine oxide, aryl phosphine oxide, alkyl aryl phosphine oxide, alkyl phosphine sulfide, aryl phosphine sulfide, alkyl aryl phosphine sulfide, alkyl phosphonic acid, aryl phosphonic acid, alkyl phosphinic acid, aryl phosphinic acid, alkyl phosphinous acid, aryl phosphinous acid, phosphate, thiophosphate, phosphite, pyrophosphite, triphosphate, hydrogen phosphate, dihydrogen phosphate, alkyl guanidino, aryl guanidino, alkyl aryl guanidino, alkyl carbamate, aryl carbamate, alkyl aryl carbamate, alkyl thiocarbamate aryl thiocarbamate, alkyl aryl thiocarbamate, alkyl dithiocarbamate, aryl dithiocarbamate, alkyl aryl dithiocarbamate, bicarbonate, carbonate, perchlorate, chlorate, chlorite, hypochlorite, perbromate, bromate, bromite, hypobromite, tetrahalomanganate, tetrafluoroborate, hexafluorophosphate, hexafluoroantimonate, hypophosphite, iodate, periodate, metaborate, tetraaryl borate, tetra alkyl borate, tartrate, salicylate, succinate, citrate, ascorbate, saccharinate, amino acid, hydroxamic acid, thiotosylate, and anions of ion exchange resins.

21. (Previously amended) The modified biomaterial of claim 18, wherein the non-proteinaceous catalyst for the dismutation of superoxide is selected from the group consisting of Compounds 1-54 of Table 1.

22. (Previously amended) The modified biomaterial of claim 18, wherein the non-proteinaceous catalyst for the dismutation of superoxide is selected from the group consisting of Compounds 16, 27, 38, 40, 42, 43, 51, 52, 53, and 54 of Table 1.

23. (Previously amended) The modified biomaterial of claim 19, 20, 21, or 22, wherein the non-proteinaceous catalyst is present at a concentration of about 0.001 to about 25 weight percent.

24. (Previously amended) The modified biomaterial of claim 19, 20, 21, or 22, wherein the non-proteinaceous catalyst is present at a concentration of about 0.01 to about 10 weight percent.

25. (Previously amended) The modified biomaterial of claim 19, 20, 21, or 22, wherein the non-proteinaceous catalyst is present at a concentration of about 0.05 to about 5 weight percent.

26. (Previously amended) The modified biomaterial of claim 197, wherein the biomaterial substantially compatible with a biological system is a polymer selected from the group consisting of: polyurethane, polyurethaneurethane, polyalkylene glycols, polyethylene terephthalate, ultra high molecular weight polyethylene, polypropylene, polyesters, polyamides,

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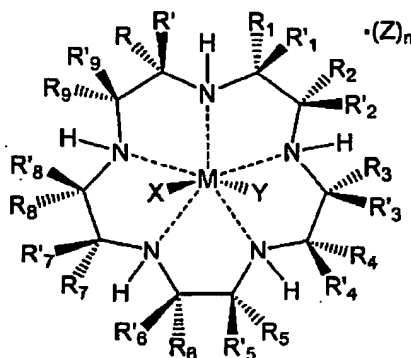
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polycarbonates, polyorthoesters, polyesteramides, polysiloxane, polyolefins, polytetrafluoroethylene, polysulfones, polyanhydrides, polyalkylene oxides, polyvinyl halides, polyvinylidene halides, acrylic, methacrylic, polyacrylonitrile, polyvinyl, polyphosphazene, polyethylene-co-acrylic acid, silicone, block copolymer of any of the foregoing polymers, random copolymers of any of the foregoing polymers, graft copolymers of any of the foregoing polymers, crosslinked polymers of any of the foregoing polymers, hydrogels, and mixtures of any of the foregoing polymers.

27. (Previously amended) The modified biomaterial of claim 26, wherein the non-proteinaceous catalyst for the dismutation of superoxide is selected from the group consisting of manganese(II) pentaaza complexes, manganese(III) pentaaza complexes, iron(II) pentaaza complexes, iron(III) pentaaza complexes, manganese(II) salen complexes, manganese(III) salen complexes, iron(II) salen complexes, iron(III) salen complexes, manganese(II) porphyrin complexes, manganese(III) porphyrin complexes, iron(II) porphyrin complexes, and iron(III) porphyrin complexes.

28. (Previously amended) The modified biomaterial of claim 26, wherein the non-proteinaceous catalyst for the dismutation of superoxide is selected from the group consisting of manganese and iron chelates of pentaazacyclopentadecane compounds, which are represented by the following formula:



wherein M is a cation of a transition metal selected from the group consisting of manganese and iron;

wherein R, R', R<sub>1</sub>, R'<sub>1</sub>, R<sub>2</sub>, R'<sub>2</sub>, R<sub>3</sub>, R'<sub>3</sub>, R<sub>4</sub>, R'<sub>4</sub>, R<sub>5</sub>, R'<sub>5</sub>, R<sub>6</sub>, R'<sub>6</sub>, R<sub>7</sub>, R'<sub>7</sub>, R<sub>8</sub>, R'<sub>8</sub>, and R'<sub>9</sub> independently represent hydrogen, or substituted or unsubstituted alkyl, alkenyl, alkynyl, cycloalkyl, cycloalkenyl, cycloalkylalkyl, cycloalkylcycloalkyl, cycloalkenylalkyl, alkylcycloalkyl, alkylcycloalkenyl, alkenylcycloalkyl, alkenylcycloalkenyl, heterocyclic, aryl and aralkyl radicals;

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wherein  $R_1$  or  $R'_1$  and  $R_2$  or  $R'_2$ ,  $R_3$  or  $R'_3$  and  $R_4$  or  $R'_4$ ,  $R_5$  or  $R'_5$  and  $R_6$  or  $R'_6$ ,  $R_7$  or  $R'_7$  and  $R_8$  or  $R'_8$ , and  $R_9$  or  $R'_9$  and  $R$  or  $R'$  together with the carbon atoms to which they are attached independently form a substituted or unsubstituted, saturated, partially saturated or unsaturated cyclic or heterocyclic having 3 to 20 carbon atoms;

wherein  $R$  or  $R'$  and  $R_1$  or  $R'_1$ ,  $R_2$  or  $R'_2$  and  $R_3$  or  $R'_3$ ,  $R_4$  or  $R'_4$  and  $R_5$  or  $R'_5$ ,  $R_6$  or  $R'_6$  and  $R_7$  or  $R'_7$ , and  $R_8$  or  $R'_8$  and  $R_9$  or  $R'_9$  together with the carbon atoms to which they are attached independently form a substituted or unsubstituted nitrogen containing heterocycle having 2 to 20 carbon atoms, provided that when the nitrogen containing heterocycle is an aromatic heterocycle which does not contain a hydrogen attached to the nitrogen, the hydrogen attached to the nitrogen as shown in the above formula, which nitrogen is also in the macrocyclic ligand or complex, and the  $R$  groups attached to the included carbon atoms of the macrocycle are absent;

wherein  $R$  and  $R'$ ,  $R_1$  and  $R'_1$ ,  $R_2$  and  $R'_2$ ,  $R_3$  and  $R'_3$ ,  $R_4$  and  $R'_4$ ,  $R_5$  and  $R'_5$ ,  $R_6$  and  $R'_6$ ,  $R_7$  and  $R'_7$ ,  $R_8$  and  $R'_8$ , and  $R_9$  and  $R'_9$  together with the carbon atom to which they are attached independently form a saturated, partially saturated, or unsaturated cyclic or heterocyclic having 3 to 20 carbon atoms; and

wherein one of  $R$ ,  $R'$ ,  $R_1$ ,  $R'_1$ ,  $R_2$ ,  $R'_2$ ,  $R_3$ ,  $R'_3$ ,  $R_4$ ,  $R'_4$ ,  $R_5$ ,  $R'_5$ ,  $R_6$ ,  $R'_6$ ,  $R_7$ ,  $R'_7$ ,  $R_8$ ,  $R'_8$ ,  $R_9$ , and  $R'_9$  together with a different one of  $R$ ,  $R'$ ,  $R_1$ ,  $R'_1$ ,  $R_2$ ,  $R'_2$ ,  $R_3$ ,  $R'_3$ ,  $R_4$ ,  $R'_4$ ,  $R_5$ ,  $R'_5$ ,  $R_6$ ,  $R'_6$ ,  $R_7$ ,  $R'_7$ ,  $R_8$ ,  $R'_8$ ,  $R_9$ , and  $R'_9$  which is attached to a different carbon atom in the macrocyclic ligand may be bound to form a strap represented by the formula:



wherein  $w$ ,  $x$ ,  $y$  and  $z$  independently are integers from 0 to 10 and  $M$ ,  $L$  and  $J$  are independently selected from the group consisting of alkyl, alkenyl, alkynyl, aryl, cycloalkyl, heteroaryl, alkaryl, alkheteroaryl, aza, amide, ammonium, oxa, thia, sulfonyl, sulfinyl, sulfonamide, phosphoryl, phosphinyl, phosphino, phosphonium, keto, ester, alcohol, carbamate, urea, thiocarbonyl, borates, boranes, boraza, silyl, siloxy, silaza and combinations thereof; and combinations thereof; and

wherein  $X$ ,  $Y$  and  $Z$  are independently selected from the group consisting of halide, oxo, aquo, hydroxo, alcohol, phenol, dioxygen, peroxo, hydroperoxo, alkylperoxo, arylperoxo, ammonla, alkylamino, arylamino, heterocycloalkyl amino, heterocycloaryl amino, amine oxides, hydrazine, alkyl hydrazine, aryl hydrazine, nitric oxide, cyanide, cyanate, thiocyanate, isocyanate, isothiocyanate, alkyl nitrile, aryl nitrile, alkyl isonitrile, aryl isonitrile, nitrate, nitrite, azido, alkyl sulfonic acid, aryl sulfonic acid, alkyl sulfoxide, aryl sulfoxide, alkyl aryl sulfoxide,

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alkyl sulfenic acid, aryl sulfenic acid, alkyl sulfinic acid, aryl sulfinic acid, alkyl thiol carboxylic acid, aryl thiol carboxylic acid, alkyl thiol thiocarboxylic acid, aryl thiol thiocarboxylic acid, alkyl carboxylic acid (such as acetic acid, trifluoroacetic acid, oxalic acid), aryl carboxylic acid (such as benzoic acid, phthalic acid), urea, alkyl urea, aryl urea, alkyl aryl urea, thiourea, alkyl thiourea, aryl thiourea, alkyl aryl thiourea, sulfate, sulfite, bisulfate, bisulfite, thiosulfate, thiosulfite, hydrosulfite, alkyl phosphine, aryl phosphine, alkyl phosphine oxide, aryl phosphine oxide, alkyl aryl phosphine oxide, alkyl phosphine sulfide, aryl phosphine sulfide, alkyl aryl phosphine sulfide, alkyl phosphonic acid, aryl phosphonic acid, alkyl phosphinic acid, aryl phosphinic acid, alkyl phosphinous acid, aryl phosphinous acid, phosphate, thiophosphate, phosphite, pyrophosphite, triphosphate, hydrogen phosphate, dihydrogen phosphate, alkyl guanidino, aryl guanidino, alkyl aryl guanidino, alkyl carbamate, aryl carbamate, alkyl aryl carbamate, alkyl thiocarbamate aryl thiocarbamate, alkyl aryl thiocarbamate, alkyl dithiocarbamate, aryl dithiocarbamate, alkyl aryl dithiocarbamate, bicarbonate, carbonate, perchlorate, chlorate, chlorite, hypochlorite, perbromate, bromate, bromite, hypobromite, tetrahalomanganate, tetrafluoroborate, hexafluorophosphate, hexafluoroantimonate, hypophosphite, iodate, periodate, metaborate, tetraaryl borate, tetra alkyl borate, tartrate, salicylate, succinate, citrate, ascorbate, saccharinate, amino acid, hydroxamic acid, thiotosylate, and anions of ion exchange resins.

29. (Previously amended) The modified biomaterial of claim 26, wherein the non-proteinaceous catalyst for the dismutation of superoxide is selected from the group consisting of Compounds 1-54 of Table 1.

30. (Previously amended) The modified biomaterial of claim 26, wherein the non-proteinaceous catalyst for the dismutation of superoxide is selected from the group consisting of Compounds 16, 27, 38, 40, 42, 43, 51, 52, 53, and 54 of Table 1.

31. (Previously amended) The modified biomaterial of claim 27, 28, 29, or 30, wherein the non-proteinaceous catalyst is present at a concentration of about 0.001 to about 25 weight percent.

32. (Previously amended) The modified biomaterial of claim 27, 28, 29, or 30, wherein the non-proteinaceous catalyst is present at a concentration of about 0.01 to about 10 weight percent.

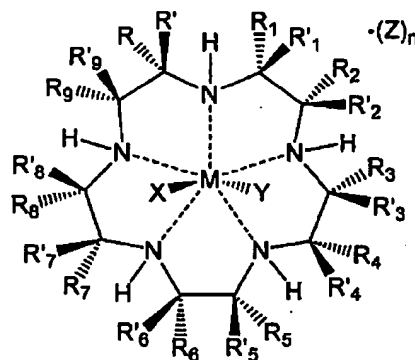
33. (Previously amended) The modified biomaterial of claim 27, 28, 29, or 30, wherein the non-proteinaceous catalyst is present at a concentration of about 0.05 to about 5 weight percent.

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34. (Previously amended) The modified biomaterial of claim 197, wherein the biomaterial substantially compatible with a biological system is a polyethylene glycol.

35. (Previously amended) The modified biomaterial of claim 34, wherein the non-proteinaceous catalyst for the dismutation of superoxide is selected from the group consisting of manganese(II) pentaaza complexes, manganese(III) pentaaza complexes, iron(II) pentaaza complexes, iron(III) pentaaza complexes, manganese(II) salen complexes, manganese(III) salen complexes, iron(II) salen complexes, iron(III) salen complexes, manganese(II) porphyrin complexes, manganese(III) porphyrin complexes, iron(II) porphyrin complexes, and iron(III) porphyrin complexes.

36. (Previously amended) The modified biomaterial of claim 34, wherein the non-proteinaceous catalyst for the dismutation of superoxide is selected from the group consisting of manganese and iron chelates of pentaazacyclopentadecane compounds, which are represented by the following formula:



wherein M is a cation of a transition metal selected from the group consisting of manganese and iron;

wherein R, R', R<sub>1</sub>, R'<sub>1</sub>, R<sub>2</sub>, R'<sub>2</sub>, R<sub>3</sub>, R'<sub>3</sub>, R<sub>4</sub>, R'<sub>4</sub>, R<sub>5</sub>, R'<sub>5</sub>, R<sub>6</sub>, R'<sub>6</sub>, R<sub>7</sub>, R'<sub>7</sub>, R<sub>8</sub>, R'<sub>8</sub>, R<sub>9</sub>, and R'<sub>9</sub> independently represent hydrogen, or substituted or unsubstituted alkyl, alkenyl, alkynyl, cycloalkyl, cycloalkenyl, cycloalkylalkyl, cycloalkylcycloalkyl, cycloalkenylalkyl, alkylcycloalkyl, alkylcycloalkenyl, alkenylcycloalkyl, alkenylcycloalkenyl, heterocyclic, aryl and aralkyl radicals;

wherein R<sub>1</sub> or R'<sub>1</sub> and R<sub>2</sub> or R'<sub>2</sub>, R<sub>3</sub> or R'<sub>3</sub> and R<sub>4</sub> or R'<sub>4</sub>, R<sub>5</sub> or R'<sub>5</sub> and R<sub>6</sub> or R'<sub>6</sub>, R<sub>7</sub> or R'<sub>7</sub> and R<sub>8</sub> or R'<sub>8</sub>, and R<sub>9</sub> or R'<sub>9</sub> and R or R' together with the carbon atoms to which they are attached independently form a substituted or unsubstituted, saturated, partially saturated or unsaturated cyclic or heterocyclic having 3 to 20 carbon atoms;

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wherein R or R' and R<sub>1</sub> or R'<sub>1</sub>, R<sub>2</sub> or R'<sub>2</sub> and R<sub>3</sub> or R'<sub>3</sub>, R<sub>4</sub> or R'<sub>4</sub> and R<sub>5</sub> or R'<sub>5</sub>, R<sub>6</sub> or R'<sub>6</sub> and R<sub>7</sub> or R'<sub>7</sub>, and R<sub>8</sub> or R'<sub>8</sub> and R<sub>9</sub> or R'<sub>9</sub> together with the carbon atoms to which they are attached independently form a substituted or unsubstituted nitrogen containing heterocycle having 2 to 20 carbon atoms, provided that when the nitrogen containing heterocycle is an aromatic heterocycle which does not contain a hydrogen attached to the nitrogen, the hydrogen attached to the nitrogen as shown in the above formula, which nitrogen is also in the macrocyclic ligand or complex, and the R groups attached to the included carbon atoms of the macrocycle are absent;

wherein R and R', R<sub>1</sub> and R'<sub>1</sub>, R<sub>2</sub> and R'<sub>2</sub>, R<sub>3</sub> and R'<sub>3</sub>, R<sub>4</sub> and R'<sub>4</sub>, R<sub>5</sub> and R'<sub>5</sub>, R<sub>6</sub> and R'<sub>6</sub>, R<sub>7</sub> and R'<sub>7</sub>, R<sub>8</sub> and R'<sub>8</sub>, and R<sub>9</sub> and R'<sub>9</sub> together with the carbon atom to which they are attached independently form a saturated, partially saturated, or unsaturated cyclic or heterocyclic having 3 to 20 carbon atoms; and

wherein one of R, R', R<sub>1</sub>, R'<sub>1</sub>, R<sub>2</sub>, R'<sub>2</sub>, R<sub>3</sub>, R'<sub>3</sub>, R<sub>4</sub>, R'<sub>4</sub>, R<sub>5</sub>, R'<sub>5</sub>, R<sub>6</sub>, R'<sub>6</sub>, R<sub>7</sub>, R'<sub>7</sub>, R<sub>8</sub>, R'<sub>8</sub>, R<sub>9</sub>, and R'<sub>9</sub> together with a different one of R, R', R<sub>1</sub>, R'<sub>1</sub>, R<sub>2</sub>, R'<sub>2</sub>, R<sub>3</sub>, R'<sub>3</sub>, R<sub>4</sub>, R'<sub>4</sub>, R<sub>5</sub>, R'<sub>5</sub>, R<sub>6</sub>, R'<sub>6</sub>, R<sub>7</sub>, R'<sub>7</sub>, R<sub>8</sub>, R'<sub>8</sub>, R<sub>9</sub>, and R'<sub>9</sub> which is attached to a different carbon atom in the macrocyclic ligand may be bound to form a strap represented by the formula:



wherein w, x, y and z independently are integers from 0 to 10 and M, L and J are independently selected from the group consisting of alkyl, alkenyl, alkynyl, aryl, cycloalkyl, heteroaryl, alkaryl, alkheteroaryl, aza, amide, ammonium, oxa, thia, sulfonyl, sulfinyl, sulfonamide, phosphoryl, phosphinyl, phosphino, phosphonium, keto, ester, alcohol, carbamate, urea, thiocarbonyl, borates, boranes, boraza, silyl, siloxy, silaza and combinations thereof; and combinations thereof; and

wherein X, Y and Z are independently selected from the group consisting of halide, oxo, aquo, hydroxo, alcohol, phenol, dioxygen, peroxo, hydroperoxo, alkylperoxo, arylperoxo, ammonia, alkylamino, arylamino, heterocycloalkyl amino, heterocycloaryl amino, amine oxides, hydrazine, alkyl hydrazine, aryl hydrazine, nitric oxide, cyanide, cyanate, thiocyanate, isocyanate, isothiocyanate, alkyl nitrile, aryl nitrile, alkyl isonitrile, aryl isonitrile, nitrate, nitrite, azido, alkyl sulfonic acid, aryl sulfonic acid, alkyl sulfoxide, aryl sulfoxide, alkyl aryl sulfoxide, alkyl sulfenic acid, aryl sulfenic acid, alkyl sulfinic acid, aryl sulfinic acid, alkyl thiol carboxylic acid, aryl thiol carboxylic acid, alkyl thiol thiocarboxylic acid, aryl thiol thiocarboxylic acid, alkyl carboxylic acid (such as acetic acid, trifluoroacetic acid, oxalic acid), aryl carboxylic acid (such as benzoic acid, phthalic acid), urea, alkyl urea, aryl urea, alkyl aryl urea, thiourea, alkyl

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thiourea, aryl thiourea, alkyl aryl thiourea, sulfate, sulfite, bisulfate, bisulfite, thiosulfate, thiosulfite, hydrosulfite, alkyl phosphine, aryl phosphine, alkyl phosphine oxide, aryl phosphine oxide, alkyl aryl phosphine oxide, alkyl phosphine sulfide, aryl phosphine sulfide, alkyl aryl phosphine sulfide, alkyl phosphonic acid, aryl phosphonic acid, alkyl phosphinic acid, aryl phosphinic acid, alkyl phosphinous acid, aryl phosphinous acid, phosphate, thiophosphate, phosphite, pyrophosphite, triphosphate, hydrogen phosphate, dihydrogen phosphate, alkyl guanidino, aryl guanidino, alkyl aryl guanidino, alkyl carbamate, aryl carbamate, alkyl aryl carbamate, alkyl thiocarbamate, aryl thiocarbamate, alkyl aryl thiocarbamate, alkyl dithiocarbamate, aryl dithiocarbamate, alkyl aryl dithiocarbamate, bicarbonate, carbonate, perchlorate, chlorate, chlorite, hypochlorite, perbromate, bromate, bromite, hypobromite, tetrahalomanganate, tetrafluoroborate, hexafluorophosphate, hexafluoroantimonate, hypophosphite, iodate, periodate, metaborate, tetraaryl borate, tetra alkyl borate, tartrate, salicylate, succinate, citrate, ascorbate, saccharinate, amino acid, hydroxamic acid, thiotosylate, and anions of ion exchange resins.

37. (Previously amended) The modified biomaterial of claim 34, wherein the non-proteinaceous catalyst for the dismutation of superoxide is selected from the group consisting of Compounds 1-54 of Table 1.

38. (Previously amended) The modified biomaterial of claim 34, wherein the non-proteinaceous catalyst for the dismutation of superoxide is selected from the group consisting of Compounds 16, 27, 38, 40, 42, 43, 51, 52, 53, and 54 of Table 1.

39. (Previously amended) The modified biomaterial of claim 35, 36, 37, or 38, wherein the non-proteinaceous catalyst is present at a concentration of about 0.001 to about 25 weight percent.

40. (Previously amended) The modified biomaterial of claim 35, 36, 37, or 38, wherein the non-proteinaceous catalyst is present at a concentration of about 0.01 to about 10 weight percent.

41. (Previously amended) The modified biomaterial of claim 35, 36, 37, or 38, wherein the non-proteinaceous catalyst is present at a concentration of about 0.05 to about 5 weight percent.

42. (Previously amended) The modified biomaterial of claim 197, wherein the biomaterial substantially compatible with a biological system is a biopolymer selected from the group consisting of chitin, chitosan, cellulose, methyl cellulose, keratin, fibroin, collagen, elastin, and saccharide polymers.

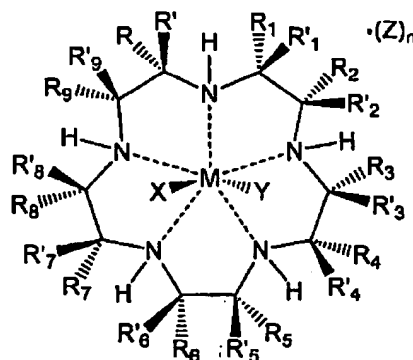
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43. (Previously amended) The modified biomaterial of claim 42, wherein the non-proteinaceous catalyst for the dismutation of superoxide is selected from the group consisting of manganese(II) pentaaza complexes, manganese(III) pentaaza complexes, iron(II) pentaaza complexes, iron(III) pentaaza complexes, manganese(II) salen complexes, manganese(III) salen complexes, iron(II) salen complexes, iron(III) salen complexes, manganese(II) porphyrin complexes, manganese(III) porphyrin complexes, iron(II) porphyrin complexes, and iron(III) porphyrin complexes.

44. (Previously amended) The modified biomaterial of claim 42, wherein the non-proteinaceous catalyst for the dismutation of superoxide is selected from the group consisting of manganese and iron chelates of pentaazacyclopentadecane compounds, which are represented by the following formula:



wherein M is a cation of a transition metal selected from the group consisting of manganese and iron;

wherein R, R', R<sub>1</sub>, R'<sub>1</sub>, R<sub>2</sub>, R'<sub>2</sub>, R<sub>3</sub>, R'<sub>3</sub>, R<sub>4</sub>, R'<sub>4</sub>, R<sub>5</sub>, R'<sub>5</sub>, R<sub>6</sub>, R'<sub>6</sub>, R<sub>7</sub>, R'<sub>7</sub>, R<sub>8</sub>, R'<sub>8</sub>, R<sub>9</sub>, and R'<sub>9</sub> independently represent hydrogen, or substituted or unsubstituted alkyl, alkenyl, alkynyl, cycloalkyl, cycloalkenyl, cycloalkylalkyl, cycloalkylcycloalkyl, cycloalkenylalkyl, alkylcycloalkyl, alkylcycloalkenyl, alkenylcycloalkyl, alkenylcycloalkenyl, heterocyclic, aryl and aralkyl radicals;

wherein R<sub>1</sub> or R'<sub>1</sub> and R<sub>2</sub> or R'<sub>2</sub>, R<sub>3</sub> or R'<sub>3</sub> and R<sub>4</sub> or R'<sub>4</sub>, R<sub>5</sub> or R'<sub>5</sub> and R<sub>6</sub> or R'<sub>6</sub>, R<sub>7</sub> or R'<sub>7</sub> and R<sub>8</sub> or R'<sub>8</sub>, and R<sub>9</sub> or R'<sub>9</sub> and R or R' together with the carbon atoms to which they are attached independently form a substituted or unsubstituted, saturated, partially saturated or unsaturated cyclic or heterocyclic having 3 to 20 carbon atoms;

wherein R or R' and R<sub>1</sub> or R'<sub>1</sub>, R<sub>2</sub> or R'<sub>2</sub> and R<sub>3</sub> or R'<sub>3</sub>, R<sub>4</sub> or R'<sub>4</sub> and R<sub>5</sub> or R'<sub>5</sub>, R<sub>6</sub> or R'<sub>6</sub> and R<sub>7</sub> or R'<sub>7</sub>, and R<sub>8</sub> or R'<sub>8</sub> and R<sub>9</sub> or R'<sub>9</sub> together with the carbon atoms to which they are attached independently form a substituted or unsubstituted nitrogen containing heterocycle



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having 2 to 20 carbon atoms, provided that when the nitrogen containing heterocycle is an aromatic heterocycle which does not contain a hydrogen attached to the nitrogen, the hydrogen attached to the nitrogen as shown in the above formula, which nitrogen is also in the macrocyclic ligand or complex, and the R groups attached to the included carbon atoms of the macrocycle are absent;

wherein R and R', R<sub>1</sub> and R'<sub>1</sub>, R<sub>2</sub> and R'<sub>2</sub>, R<sub>3</sub> and R'<sub>3</sub>, R<sub>4</sub> and R'<sub>4</sub>, R<sub>5</sub> and R'<sub>5</sub>, R<sub>6</sub> and R'<sub>6</sub>, R<sub>7</sub> and R'<sub>7</sub>, R<sub>8</sub> and R'<sub>8</sub>, and R<sub>9</sub> and R'<sub>9</sub> together with the carbon atom to which they are attached independently form a saturated, partially saturated, or unsaturated cyclic or heterocyclic having 3 to 20 carbon atoms; and

wherein one of R, R', R<sub>1</sub>, R'<sub>1</sub>, R<sub>2</sub>, R'<sub>2</sub>, R<sub>3</sub>, R'<sub>3</sub>, R<sub>4</sub>, R'<sub>4</sub>, R<sub>5</sub>, R'<sub>5</sub>, R<sub>6</sub>, R'<sub>6</sub>, R<sub>7</sub>, R'<sub>7</sub>, R<sub>8</sub>, R'<sub>8</sub>, R<sub>9</sub>, and R'<sub>9</sub> together with a different one of R, R', R<sub>1</sub>, R'<sub>1</sub>, R<sub>2</sub>, R'<sub>2</sub>, R<sub>3</sub>, R'<sub>3</sub>, R<sub>4</sub>, R'<sub>4</sub>, R<sub>5</sub>, R'<sub>5</sub>, R<sub>6</sub>, R'<sub>6</sub>, R<sub>7</sub>, R'<sub>7</sub>, R<sub>8</sub>, R'<sub>8</sub>, R<sub>9</sub>, and R'<sub>9</sub> which is attached to a different carbon atom in the macrocyclic ligand may be bound to form a strap represented by the formula:



wherein w, x, y and z independently are integers from 0 to 10 and M, L and J are independently selected from the group consisting of alkyl, alkenyl, alkynyl, aryl, cycloalkyl, heteroaryl, alkaryl, alkheteroaryl, aza, amide, ammonium, oxa, thia, sulfonyl, sulfinyl, sulfonamide, phosphoryl, phosphinyl, phosphino, phosphonium, keto, ester, alcohol, carbamate, urea, thiocarbonyl, borates, boranes, boraza, silyl, siloxy, silaza and combinations thereof; and combinations thereof; and

wherein X, Y and Z are independently selected from the group consisting of halide, oxo, aquo, hydroxo, alcohol, phenol, dioxygen, peroxy, hydroperoxy, alkylperoxy, arylperoxy, ammonia, alkylamino, arylamino, heterocycloalkyl amino, heterocycloaryl amino, amine oxides, hydrazine, alkyl hydrazine, aryl hydrazine, nitric oxide, cyanide, cyanate, thiocyanate, isocyanate, isothiocyanate, alkyl nitrile, aryl nitrile, alkyl isonitrile, aryl isonitrile, nitrate, nitrite, azido, alkyl sulfonic acid, aryl sulfonic acid, alkyl sulfoxide, aryl sulfoxide, alkyl aryl sulfoxide, alkyl sulfenic acid, aryl sulfenic acid, alkyl sulfinic acid, aryl sulfinic acid, alkyl thiol carboxylic acid, aryl thiol carboxylic acid, alkyl thiol thiocarboxylic acid, aryl thiol thiocarboxylic acid, alkyl carboxylic acid (such as acetic acid, trifluoroacetic acid, oxalic acid), aryl carboxylic acid (such as benzoic acid, phthalic acid), urea, alkyl urea, aryl urea, alkyl aryl urea, thiourea, alkyl thiourea, aryl thiourea, alkyl aryl thiourea, sulfate, sulfite, bisulfate, bisulfite, thiosulfate, thiosulfite, hydrosulfite, alkyl phosphine, aryl phosphine, alkyl phosphine oxide, aryl phosphine oxide, alkyl aryl phosphine oxide, alkyl phosphine sulfide, aryl phosphine sulfide, alkyl aryl

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phosphine sulfide, alkyl phosphonic acid, aryl phosphonic acid, alkyl phosphinic acid, aryl phosphinic acid, alkyl phosphinous acid, aryl phosphinous acid, phosphate, thiophosphate, phosphite, pyrophosphite, triphosphate, hydrogen phosphate, dihydrogen phosphate, alkyl guanidino, aryl guanidino, alkyl aryl guanidino, alkyl carbamate, aryl carbamate, alkyl aryl carbamate, alkyl thiocarbamate aryl thiocarbamate, alkyl aryl thiocarbamate, alkyl dithiocarbamate, aryl dithiocarbamate, alkyl aryl dithiocarbamate, bicarbonate, carbonate, perchlorate, chlorate, chlorite, hypochlorite, perbromate, bromate, bromite, hypobromite, tetrahalomanganate, tetrafluoroborate, hexafluorophosphate, hexafluoroantimonate, hypophosphite, iodate, periodate, metaborate, tetraaryl borate, tetra alkyl borate, tartrate, salicylate, succinate, citrate, ascorbate, saccharinate, amino acid, hydroxamic acid, thiotosylate, and anions of ion exchange resins.

45. (Previously amended) The modified biomaterial of claim 42, wherein the non-proteinaceous catalyst for the dismutation of superoxide is selected from the group consisting of Compounds 1-54 of Table 1.

46. (Previously amended) The modified biomaterial of claim 42, wherein the non-proteinaceous catalyst for the dismutation of superoxide is selected from the group consisting of Compounds 16, 27, 38, 40, 42, 43, 51, 52, 53, and 54 of Table 1.

47. (Previously amended) The modified biomaterial of claim 43, 44, 45, or 46, wherein the non-proteinaceous catalyst is present at a concentration of about 0.001 to about 25 weight percent.

48. (Previously amended) The modified biomaterial of claim 43, 44, 45, or 46, wherein the non-proteinaceous catalyst is present at a concentration of about 0.01 to about 10 weight percent.

49. (Previously amended) The modified biomaterial of claim 43, 44, 45, or 46, wherein the non-proteinaceous catalyst is present at a concentration of about 0.05 to about 5 weight percent.

50. (Previously amended) The modified biomaterial of claim 197, wherein the biomaterial substantially compatible with a biological system is a composite material comprising a relatively inelastic phase selected from the group consisting of carbon, hydroxy apatite, tricalcium phosphate, silicates, ceramics, and metals, and a relatively elastic phase selected from the group consisting of polymers and biopolymers.

51. (Previously amended) The modified biomaterial of claim 50, wherein the non-proteinaceous catalyst for the dismutation of superoxide is selected from the group consisting of

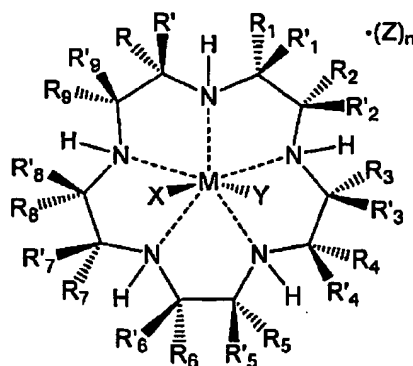
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manganese(II) pentaaza complexes, manganese(III) pentaaza complexes, iron(II) pentaaza complexes, iron(III) pentaaza complexes, manganese(II) salen complexes, manganese(III) salen complexes, iron(II) salen complexes, iron(III) salen complexes, manganese(II) porphyrin complexes, manganese(III) porphyrin complexes, iron(II) porphyrin complexes, and iron(III) porphyrin complexes.

52. (Previously amended) The modified biomaterial of claim 50, wherein the non-proteinaceous catalyst for the dismutation of superoxide is selected from the group consisting of manganese and iron chelates of pentaazacyclopentadecane compounds, which are represented by the following formula:



wherein M is a cation of a transition metal selected from the group consisting of manganese and iron;

wherein R, R', R<sub>1</sub>, R'<sub>1</sub>, R<sub>2</sub>, R'<sub>2</sub>, R<sub>3</sub>, R'<sub>3</sub>, R<sub>4</sub>, R'<sub>4</sub>, R<sub>5</sub>, R'<sub>5</sub>, R<sub>6</sub>, R'<sub>6</sub>, R<sub>7</sub>, R'<sub>7</sub>, R<sub>8</sub>, R'<sub>8</sub>, R<sub>9</sub>, and R'<sub>9</sub> independently represent hydrogen, or substituted or unsubstituted alkyl, alkenyl, alkynyl, cycloalkyl, cycloalkenyl, cycloalkylalkyl, cycloalkylcycloalkyl, cycloalkenylalkyl, alkylcycloalkyl, alkylcycloalkenyl, alkenylcycloalkyl, alkenylcycloalkenyl, heterocyclic, aryl and aralkyl radicals;

wherein R<sub>1</sub> or R'<sub>1</sub> and R<sub>2</sub> or R'<sub>2</sub>, R<sub>3</sub> or R'<sub>3</sub> and R<sub>4</sub> or R'<sub>4</sub>, R<sub>5</sub> or R'<sub>5</sub> and R<sub>6</sub> or R'<sub>6</sub>, R<sub>7</sub> or R'<sub>7</sub> and R<sub>8</sub> or R'<sub>8</sub>, and R<sub>9</sub> or R'<sub>9</sub> and R or R' together with the carbon atoms to which they are attached independently form a substituted or unsubstituted, saturated, partially saturated or unsaturated cyclic or heterocyclic having 3 to 20 carbon atoms;

wherein R or R' and R<sub>1</sub> or R'<sub>1</sub>, R<sub>2</sub> or R'<sub>2</sub> and R<sub>3</sub> or R'<sub>3</sub>, R<sub>4</sub> or R'<sub>4</sub> and R<sub>5</sub> or R'<sub>5</sub>, R<sub>6</sub> or R'<sub>6</sub> and R<sub>7</sub> or R'<sub>7</sub>, and R<sub>8</sub> or R'<sub>8</sub> and R<sub>9</sub> or R'<sub>9</sub> together with the carbon atoms to which they are attached independently form a substituted or unsubstituted nitrogen containing heterocycle having 2 to 20 carbon atoms, provided that when the nitrogen containing heterocycle is an aromatic heterocycle which does not contain a hydrogen attached to the nitrogen, the hydrogen

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attached to the nitrogen as shown in the above formula, which nitrogen is also in the macrocyclic ligand or complex, and the R groups attached to the included carbon atoms of the macrocycle are absent;

wherein R and R', R<sub>1</sub> and R'<sub>1</sub>, R<sub>2</sub> and R'<sub>2</sub>, R<sub>3</sub> and R'<sub>3</sub>, R<sub>4</sub> and R'<sub>4</sub>, R<sub>5</sub> and R'<sub>5</sub>, R<sub>6</sub> and R'<sub>6</sub>, R<sub>7</sub> and R'<sub>7</sub>, R<sub>8</sub> and R'<sub>8</sub>, and R<sub>9</sub> and R'<sub>9</sub> together with the carbon atom to which they are attached independently form a saturated, partially saturated, or unsaturated cyclic or heterocyclic having 3 to 20 carbon atoms; and

wherein one of R, R', R<sub>1</sub>, R'<sub>1</sub>, R<sub>2</sub>, R'<sub>2</sub>, R<sub>3</sub>, R'<sub>3</sub>, R<sub>4</sub>, R'<sub>4</sub>, R<sub>5</sub>, R'<sub>5</sub>, R<sub>6</sub>, R'<sub>6</sub>, R<sub>7</sub>, R'<sub>7</sub>, R<sub>8</sub>, R'<sub>8</sub>, R<sub>9</sub>, and R'<sub>9</sub> together with a different one of R, R', R<sub>1</sub>, R'<sub>1</sub>, R<sub>2</sub>, R'<sub>2</sub>, R<sub>3</sub>, R'<sub>3</sub>, R<sub>4</sub>, R'<sub>4</sub>, R<sub>5</sub>, R'<sub>5</sub>, R<sub>6</sub>, R'<sub>6</sub>, R<sub>7</sub>, R<sub>8</sub>, R'<sub>8</sub>, R<sub>9</sub>, and R'<sub>9</sub> which is attached to a different carbon atom in the macrocyclic ligand may be bound to form a strap represented by the formula:



wherein w, x, y and z independently are integers from 0 to 10 and M, L and J are independently selected from the group consisting of alkyl, alkenyl, alkynyl, aryl, cycloalkyl, heteroaryl, alkaryl, alkheteroaryl, aza, amide, ammonium, oxa, thia, sulfonyl, sulfinyl, sulfonamide, phosphoryl, phosphinyl, phosphino, phosphonium, keto, ester, alcohol, carbamate, urea, thiocarbonyl, borates, boranes, boraza, silyl, siloxy, silaza and combinations thereof; and combinations thereof; and

wherein X, Y and Z are independently selected from the group consisting of halide, oxo, aquo, hydroxo, alcohol, phenol, dioxygen, peroxo, hydroperoxo, alkylperoxo, arylperoxo, ammonia, alkylamino, arylamino, heterocycloalkyl amino, heterocycloaryl amino, amine oxides, hydrazine, alkyl hydrazine, aryl hydrazine, nitric oxide, cyanide, cyanate, thiocyanate, isocyanate, isothiocyanate, alkyl nitrile, aryl nitrile, alkyl isonitrile, aryl isonitrile, nitrate, nitrite, azido, alkyl sulfonic acid, aryl sulfonic acid, alkyl sulfoxide, aryl sulfoxide, alkyl aryl sulfoxide, alkyl sulfenic acid, aryl sulfenic acid, alkyl sulfinic acid, aryl sulfinic acid, alkyl thiol carboxylic acid, aryl thiol carboxylic acid, alkyl thiol thiocarboxylic acid, aryl thiol thiocarboxylic acid, alkyl carboxylic acid (such as acetic acid, trifluoroacetic acid, oxalic acid), aryl carboxylic acid (such as benzoic acid, phthalic acid), urea, alkyl urea, aryl urea, alkyl aryl urea, thiourea, alkyl thiourea, aryl thiourea, alkyl aryl thiourea, sulfate, sulfite, bisulfate, bisulfite, thiosulfate, thiosulfite, hydrosulfite, alkyl phosphine, aryl phosphine, alkyl phosphine oxide, aryl phosphine oxide, alkyl aryl phosphine oxide, alkyl phosphine sulfide, aryl phosphine sulfide, alkyl aryl phosphine sulfide, alkyl phosphonic acid, aryl phosphonic acid, alkyl phosphinic acid, aryl phosphinic acid, alkyl phosphinous acid, aryl phosphinous acid, phosphate, thiophosphate,

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phosphite, pyrophosphite, triphosphate, hydrogen phosphate, dihydrogen phosphate, alkyl guanidino, aryl guanidino, alkyl aryl guanidino, alkyl carbamate, aryl carbamate, alkyl aryl carbamate, alkyl thiocarbamate, aryl thiocarbamate, alkyl aryl thiocarbamate, alkyl dithiocarbamate, aryl dithiocarbamate, alkyl aryl dithiocarbamate, bicarbonate, carbonate, perchlorate, chlorate, chlorite, hypochlorite, perbromate, bromate, bromite, hypobromite, tetrahalomanganate, tetrafluoroborate, hexafluorophosphate, hexafluoroantimonate, hypophosphite, iodate, periodate, metaborate, tetraaryl borate, tetra alkyl borate, tartrate, salicylate, succinate, citrate, ascorbate, saccharinate, amino acid, hydroxamic acid, thiotosylate, and anions of ion exchange resins.

53. (Previously amended) The modified biomaterial of claim 50, wherein the non-proteinaceous catalyst for the dismutation of superoxide is selected from the group consisting of Compounds 1-54 of Table 1.

54. (Previously amended) The modified biomaterial of claim 50, wherein the non-proteinaceous catalyst for the dismutation of superoxide is selected from the group consisting of Compounds 16, 27, 38, 40, 42, 43, 51, 52, 53, and 54 of Table 1.

55. (Previously amended) The modified biomaterial of claim 51, 52, 53, or 54, wherein the non-proteinaceous catalyst is present at a concentration of about 0.001 to about 25 weight percent.

56. (Previously amended) The modified biomaterial of claim 51, 52, 53, or 54, wherein the non-proteinaceous catalyst is present at a concentration of about 0.01 to about 10 weight percent.

57. (Previously amended) The modified biomaterial of claim 51, 52, 53, or 54, wherein the non-proteinaceous catalyst is present at a concentration of about 0.05 to about 5 weight percent.

58. (Previously amended) The modified biomaterial of claim 197 comprising the non-proteinaceous catalyst for the dismutation of superoxide covalently bound to the surface of the biomaterial.

59. (Previously amended) The modified biomaterial of claim 197 comprising a copolymer of the non-proteinaceous catalyst for the dismutation of superoxide and a biomaterial monomer substantially compatible with a biological system.

60. (Previously amended) The modified biomaterial of claim 197 comprising an admixture of the non-proteinaceous catalyst for the dismutation of superoxide and the biomaterial substantially compatible with a biological system.

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61. (Previously amended) The modified biomaterial of claim 197, wherein, upon exposure to a biological fluid, dissociation of the non-proteinaceous catalyst for the dismutation of superoxide or the precursor ligand from the biomaterial substantially compatible with a biological system is prevented by at least one covalent bond between the non-proteinaceous catalyst for the dismutation of superoxide or the precursor ligand and the biomaterial substantially compatible with a biological system.

62. (Previously amended) The modified biomaterial of claim 197, wherein, upon exposure to a biological fluid, dissociation of the non-proteinaceous catalyst for the dismutation of superoxide or the precursor ligand from the biomaterial substantially compatible with a biological system is prevented by ionic interactions between the non-proteinaceous catalyst for the dismutation of superoxide or the precursor ligand and the biomaterial substantially compatible with a biological system.

63. (Previously amended) The modified biomaterial of claim 197, wherein, upon exposure to biological fluid, dissociation of the non-proteinaceous catalyst for the dismutation of superoxide or the precursor ligand from the biomaterial substantially compatible with a biological system is prevented by hydrophobic interactions between the non-proteinaceous catalyst for the dismutation of superoxide or the precursor ligand and the biomaterial substantially compatible with a biological system.

64 - 196. (Withdrawn)

197. (Previously amended) A modified biomaterial useful for the dismutation of superoxide comprising:

- (a) a modified biomaterial, said material comprising
- (b) a biomaterial substantially compatible with a biological system; and
- (c) at least one non-proteinaceous catalyst or precursor ligand of the non-proteinaceous catalyst attached to the biomaterial;

wherein the non-proteinaceous catalyst is capable of dismutating superoxide in the biological system.

198. (Previously added) A modified biomaterial according to claim 197, wherein the biomaterial substantially compatible with a biological system is hyaluronic acid.

199. (New) A biomaterial modified by integrating at least one non-proteinaceous catalyst for the dismutation of superoxide or a precursor ligand of a non-proteinaceous catalyst for the dismutation of superoxide wherein superoxide dismutating ability of said integrated catalyst is retained.